APPENDIX E

TASK 5 – TECHNICAL MEMORANDUM:

TRAVEL DEMAND FORECASTING PROCESS

INTRODUCTION

The purpose of this Technical Memorandum is to describe the methodologies and assumptions used in estimating travel demand in the Highway 101 corridor and the trip reducing potential of each of the measures and strategies under consideration as alternatives to widening Highway 101 between the Santa Barbara/Ventura County line and Milpas Street.

Three packages of alternatives, measures and strategies have been formulated to accommodate travel in the Highway 101 corridor to the year 2015 or beyond. Each package is comprised of complementary transportation modes, policies and operating strategies, providing multi-modal alternatives to highway widening. All three packages provide for enhanced transportation demand management and transportation system management strategies, and improved bicycle and pedestrian networks and facilities. In addition, one package provides for implementation of rail transit with necessary support services and facilities, one package focuses on enhanced bus transit, and the final package emphasizes pricing and significantly enhanced transportation demand management strategies.

In order to evaluate the effectiveness of each of these packages in accommodating future travel demand along Highway 101 through the study area, it was necessary to forecast future (year 2015) traffic volumes in the Highway 101 corridor, assuming implementation of each of these packages.

The following sections will describe the approach that was used to estimate future traffic volume in the Highway 101 corridor assuming the measures and strategies contained in the three packages.

Overview

The Santa Barbara Travel and Emissions Model, developed in 1993 for the Santa Barbara Air Pollution Control District (APCD) in cooperation with the Santa Barbara County Association of Governments (SBCAG), was the primary tool for estimating future travel demand and traffic volumes in the South Coast area. The travel model was developed using the SYSTEM II transportation planning software package and state-of-the-art modeling techniques that meet accepted national and state standards for accuracy.

The model has been recently updated by SBCAG staff, incorporating newly approved community plan land use, Forecast ‘94 demographics, and highway capacity assumptions consistent with the latest edition of the Highway Capacity Manual (HCM). The model provides future average daily traffic volume forecasts for year 2015 assuming no improvements to Highway 101 (No-Build) and with the widening of Highway 101 to six lanes (Build).

Although the model underwent validation during the course of the update process, the model and its performance were also reviewed as part of the Highway 101 Alternatives Analysis. The review focused on the assumptions input to the model process and the resulting forecasts including:

the components of travel (internal, internal-external/external-internal, and through trips) in the Highway 101 corridor and in the County as a whole;

the allocation of trips by purpose;

the distribution of trips;

the forecast levels and characteristics of growth; and, the resulting forecast traffic volumes.

Information developed from the travel survey along Highway 101, as well as other available information such as the 1990 Census *Journey to Work* report, Traffic Solutions employer survey results, and Commuter Transportation Services *State of the Commute* were used to validate the assumptions and performance of the model. The model was found to provide reasonable and reliable forecasts of travel within the Highway 101 corridor.

In order to assess the effectiveness of the three alternative packages in accommodating travel demand in the Highway 101 corridor, the SBCAG model estimates of year 2015 trips from each zone in the SBCAG modeling area, to every other zone, in matrix format (referred to as "trip tables"), were obtained from SBCAG and converted from SYSTEM II to a format compatible with the COMSIS TDM model and the MINUTP transportation modeling software. THE COMSIS TDM model and MINUTP were then used to estimate the changes in year 2015 travel which could be expected under each of the alternative packages, and to modify the trip tables to reflect the changes.

The modified trip tables for each package were returned to SBCAG for assignment to the No Build highway network to determine the traffic volumes which could be expected along Highway 101 and the surrounding arterial system with implementation of the packages. The forecast traffic conditions for each of the alternatives could then be compared to the Build and No-Build forecasts to provide an indication of the effectiveness of the alternative packages.

Figure 1 is a flow chart of the travel forecasting process followed for each of the alternative packages. The following sections provide a detailed description of the process used to forecast future traffic conditions which would occur with each of the alternative packages.

FIGURE 1

ALTERNATIVES ANALYSIS TRAVEL FORECASTING PROCESS

The SBCAG travel model (Santa Barbara Travel Emissions Model) served as the starting point for estimating the traffic-reducing potential of the various measures contained in each of the alternative packages. The trip tables generated by the model (person and vehicle) were converted to a format compatible for input to the COMSIS TDM model using the MINUTP transportation planning software package. MINUTP was then used to factor the person trips to account for increased bicycle trips anticipated to occur with the enhancements to bicycle facilities included in each of the packages. The COMSIS TDM model was used to estimate the effects of enhanced transit service (bus or rail) and enhanced TDM applications, using the person and vehicle trip tables, by trip purpose from the SBCAG model.

The following discussion describes the SBCAG trip table development process, the methods used to convert the SBCAG trip tables to formats compatible with the TDM model, the estimation of bicycle travel and the applications of the TDM model, and finally the reassignment of the modified trip tables, adjusted for each alternative package, to the highway network.

Trip Table Development

Estimates of year 2015 travel were obtained from SBCAG’s travel model. The model was updated in June-July 1994 to incorporate the revised Regional Growth Forecasts, reflecting the levels of development forecast to occur under currently adopted General Plans and community plans.

The SBCAG travel model’s trip generation component provides estimates of person trips for seven trip types or purposes:

- Home-Work
- Home-Shop
- Home-School

- Home-Other
- Non-Home-Based-Work
- Non-Home-Based-Other
- Visitor
- Internal-External/External-Internal

The SBCAG travel model area encompasses all of Santa Barbara County. Trips which begin and end in Santa Barbara County are called internal trips and are estimated by trip purpose. Trips which have one or both ends of the trip outside of Santa Barbara County are called internal-external/external-internal (i-e/e-i) trips or through trips. I-e/e- i trips are estimated in trip generation, but the purpose of the trip is not differentiated (i.e. home-work, home-shop) as it is for internal trips. Through trips are estimated based on information obtained from Caltrans, and are added to the other components of the trip table following the mode choice step in the modeling process. Table 1 provides a summary of estimated year 2015 person trips by purpose. It also provides a summary of estimated year 2015 person trips with the revised Regional Growth Forecasts, and the previously adopted growth forecasts. Review of Table 1 shows that, with the revised Regional Growth Forecasts, the total year 2015 estimated person trips for Santa Barbara County are approximately two percent less than forecast with the previous version of growth forecasts.

The travel model was used by SBCAG to forecast travel under two scenarios: with Highway 101 remaining in its current configuration (No-Build) and with Highway 101 widened to six lanes (Build). The roadway network assumptions inherent in each of these scenarios (how Highway 101 is represented in the model) were incorporated into the modeling process, beginning with trip distribution. However, since few alternatives to Highway 101 exist for regional travel, the differing assumptions with respect to Highway 101 made little difference in trip distribution; the primary difference appears in the estimate of traffic volumes generated by the trip assignment component of the model, to be discussed later.

The mode choice component of the model separates person trips into three alternatives modes of travel:

- auto - drive alone
- auto - carpool, and
- transit.

Vehicle occupancy factors are applied to the auto-carpool person trips to generate carpool vehicle trips; the carpool vehicle trips and the auto-drive alone trips are summed to produce an estimate of vehicle trips. Table 2 summarizes estimated year 2015 vehicle trips for the No-Build and Build scenarios.

TABLE 1

TABLE 2

As a basis for estimating the potential effects of the various alternatives to the widening of Highway 101, SBCAG provided to Parsons Brinckerhoff the following trip information from their model for 1990, 2015 No-Build and 2015 Build conditions:

- Person trips by trip purpose
- Auto-drive alone person trips by purpose
- Auto-carpool person trips by purpose
- Carpool vehicle trips by purpose
- Total purpose highway vehicle trips.

The SBCAG model, as does most every travel demand model, generates trip estimates from each zone in the model to every other zone. This information is stored as binary matrices in formats defined by the specific software used to develop the model, in SBCAG's case, SYSTEM II. In order for the information to be useable by Parsons Brinckerhoff, the trip information identified above was converted by SBCAG to an ASCII formatted file, which could be read by most any PC software.

Trip Table Conversion

The trip information in ASCII format was transmitted to Parsons Brinckerhoff on diskettes. Using the travel demand modeling software, MINUTP, the ASCII records were "rebuilt" into binary trip matrices or trip tables. The MINUTP software was selected for a number of reasons. First, it was one of several software packages which Parsons-Brinckerhoff staff regularly uses and is very familiar. Like SYSTEM II, MINUTP provides state-of-the-art programming for transportation demand modeling and analyses. MINUTP is very flexible in its data format requirements, making the exercise of building and unbuilding trip tables fairly easy. Finally, since MINUTP was developed by COMSIS Corporation, as was the TDM model which would subsequently be used to evaluate trip reduction potential, transferring data between the two software packages was greatly simplified.

Figure 2 shows the process flow for the conversion and manipulation of the trip information provided by SBCAG, to obtain the information necessary to estimate the trip reduction potential of each of the alternative scenarios for Highway 101.

FIGURE 2

In addition to the trip table information provided by SBCAG, estimates of minimum travel distances and times from each zone to every other zone were also provided. This information was generated by the SBCAG model, in a binary matrix format, based on the distance and a freeflow speed assigned to each link in the mode’s highway network. This information was transferred, in ASCII format, to diskette to be rebuilt using MINUTP.

Trip Table Analyses and Modifications

The year 2015 No-Build trip tables were analyzed and modified to reflect the impacts of the measures contained in each of the alternative packages. The trip tables were modified using the Matrix program in the MINUTP software and the TDM model. The following describes the applications of these two software to analyze and modify SBCAG’s year 2015 trip tables.

<u>Estimating Bicycle Travel</u>

In addition to the primary focus of each of the alternative packages (e.g. enhanced bus transit, enhanced rail transit, enhanced transportation demand management), each of the packages include a variety of measures, activities and improvements intended to support the primary focus, and to encourage alternative travel modes to the single occupant automobile. These supporting measures and activities fall into three general categories: transportation demand management strategies, transportation system management strategies, and alternative modal support strategies. A key component of the latter are measures, activities, and improvements aimed at improving the safety, accessibility, and connectivity of pedestrian and bicycle facilities.

Bicycling and walking provide reasonable modal alternatives to the automobile for fairly short local trips. Combined with local and regional transit service, bicycling and walking can also be key components of longer or more regionally oriented trips. A study released by the U.S. Department of Transportation in April 1994 concluded that bicycling and walking as transportation modes have not been fully exploited, despite their popularity for recreation. The study cited national statistics indicating that 7.2 percent of all travel trips are made by walking, and 0.7 percent by bicycling. However, Santa Barbara, with its mild climate and agreeable topography trends somewhat ahead of the nation in bicycling as a travel mode. The *1990 Census Analysis of Journey to Work Information for Santa Barbara County* shows that in Santa Barbara County as a whole, 3.4 percent of work commute trips are made by bicycle. In the Santa Barbara Census Division, the percent of work commute trips by bicycle is 5.2 percent. By including improvements and activities which would make bicycling and walking safer, more convenient, and more comfortable, the number of people who walk or use bicycles is likely to increase.

The SBCAG travel model, like most travel demand models, does not estimate bicycle and walk trips as separate modes. Typically, walk trips are only estimated in transit mode-of-arrival modeling. Instead, these modes are indirectly accounted for when determining the appropriate trip generation rates for an area or region. The trip generation rates used in the model have been calibrated to estimate and include those person trips which will be made by motorized ground transportation. Therefore, in order to accurately reflect the effects of estimated increases in bicycling and walking on travel demand and traffic volume, it is necessary to adjust the person trips to reflect the additional increment of trips likely to be made by bicycling or walking over assumed existing levels.

The following methodology was applied to estimate the effects of increased bicycling on travel demand and traffic volume in the Highway 101 corridor. While increased walking as an alternative mode of transportation would have positive impact on local trip making and concomitant traffic volume, it is unlikely that walking would be a viable alternative for many of the trips along Highway 101 (unless the walk trip was part of a transit trip, which would be accounted for in the modeling process.) Therefore, this methodology was applied for bicycle trips only.

The first step was to determine the trips for which bicycling would serve as a likely alternative. The focus of most bicycle studies and bicycle planning has been on recreational bicycle trips and work commute trips. While the Santa Barbara area offers many inducements for recreational bicycling, these trips are not represented as a separate purpose in the travel forecasting process and would therefore be difficult to isolate and manipulate. Secondly, since the focus of the study is on reducing vehicle travel along Highway 101, this would suggest that the emphasis should be on the work commute trip as offering the greatest potential to reduce vehicle travel on Highway 101.

In addition to home-work trips, school related trips also offer significant opportunities for bicycling as an alternative mode, therefore, home-school trips were also included in the analysis of the effects of increased bicycling facilities and amenities.

Within each of those trip purposes, the trips which presented the greatest opportunity for bicycling were identified, based on trip length. The optimal length for trips which could be made by bicycle fall within a range of less than one mile to six miles; in areas of mild climate and topography, trips as long as ten miles are reasonable. Therefore, person trips for home-work and home-school trip purposes were divided into three categories: 0.01 to 6.00 miles; 6.01 to 10.00 miles, and greater than 10 miles. Table 3 shows the estimated percentage of home-work and home-school trips which would be made by bicycle in each trip length category with the alternative packages. The percentage of bicycle trips within each category is also presented.

As described previously, the *1990 Census Journey to Work* data showed that, countywide, 3.4 percent of work commute trips are presently made by bicycle. This is the level of bicycle travel which is inherent in the trip generation component of the SBCAG model, and reflected in the model's current traffic volume forecasts for both 1990 and 2015. In order to represent the increased levels of bicycling anticipated to occur with each of the alternative packages, a factor representing the <u>additional increment</u> of bicycle trips estimated to occur with each alternative, compared to the existing 3.4 percent, was applied to the 2015 home-work trips and home-school trips. Table 3 shows the number of person trips, the number of person trips by bicycle and the percentage bicycle trips represent of the total person trips.

The adjustments made to the home-work and home-school person trip tables to account for increased bicycling were carried through to the trip table development process so that they are reflected in the vehicle trip tables for these purposes as well. These adjusted trip tables along with the original trip tables received from SBCAG for the other trip purposes were then input to the TDM model.

<u>Input to the TDM Model</u>

The TDM model was used to estimate the effects of improved transit service (bus and rail) and expanded applications of transportation demand management strategies.

TABLE 3

The trip tables provided by SBCAG, which had been converted to a compatible format, were input to the TDM model (including the home-work and home-school trip tables, adjusted for increased bicycling).

Since trip-making characteristics vary with trip purpose (e.g. people are generally willing to drive further to work than to the grocery store), and since many of the strategies included in the alternative packages target particular types of trips (e.g. employer based TDM strategies and express bus service target the work commute trips), the TDM model was applied separately to each trip type for each alternatives package.

Additionally, the SBCAG model does not differentiate by trip purpose, trips with only one end within the county (internal-external/external-internal trips). Given the location of the corridor (extending to the southern border of the County) and the existing strong commute patterns between Santa Barbara County and Ventura County, it was important that the effects of the alternative packages in addressing these trips also be evaluated. Therefore, the internal-external/external-internal (i-e/e-i) trip table provided by SBCAG was split by trip type. The i-e/e-i trips were apportioned to each trip type in the same percentage as the internal trip purpose split to reflect average daily conditions. This was accomplished using the MINUTP program MATRIX and the factors were developed by dividing internal person trips by purpose into total person trips. Table 4 shows the total internal person trips and the percentage each trip purpose represents of the total for two of the alternatvies; they are representative of all of the alternatives.

The TDM model required four trip tables for each trip type as input:

- person trips
- vehicle trips

- transit trips
- carpool trips

SBCAG provided person trips, auto person trips, drive alone vehicle trips and carpool vehicle trips for each trip purpose. To obtain a transit trip table, the auto person trip table was subtracted from the person trip table, using MATRIX program. The difference was person trips by transit.

Once this process was completed for each trip purpose, the trip tables were input to the TDM model along with the appropriate assumptions to reflect the measures contained in each of the alternative packages. The following section (TDM Model Applications and Assumptions) describes the assumptions input to the TDM model for each of the alternative packages and the resulting reduction in vehicle trips.

<u>Trip Assignment Process</u>

Based on the input assumptions for each alternatives package, the TDM model estimated the potential reduction in vehicle trips likely to occur with each trip purpose. The TDM program created revised trip tables (person, vehicle, carpool and transit) for each trip purpose, based on the estimated reduction.

For each scenario, following the application of the TDM model to each trip purpose, the vehicle trip tables for each trip purpose were combined to create a total purpose trip table (see Figure E-2). The total purpose table was converted from production-attraction format to origin-destination format in preparation for assignment to the highway network.

<u>Traffic Forecast Refinement</u>

Once the process was complete, the revised trip table was converted to ASCII records and returned to SBCAG to perform the highway assignment. SBCAG used the assignment program included in the SYSTEM II software, and the No-Build (four-lane Highway 101) network to perform a capacity-restrained, daily assignment. The resulting traffic volume forecasts along each link in the highway network were plotted and provided to Parsons Brinckerhoff to continue the analysis of the alternatives

Although the model has the demonstrated ability to produce traffic volume forecasts which meet established parameters for accuracy, a countywide travel forecast model may not provide the detail or the desired accuracy for specific projects or for conducting focused area analysis. Within the Highway 101 corridor, the model is able to replicate actual traffic volumes on freeways and on high volume arterials fairly closely (generally within 10 percent). However, on lower volume roadways the model tends to be less accurate. In addition, some particularly low volume local roadways may not even be included in a countywide model, although they may have significance in reviewing a specific area.

Additionally, with the SBCAG model, between the validation of the model based on 1990 conditions, and the application of the model to forecast 2015 conditions, the capacity values assumed on the freeway system were increased from 1,600 vehicles per lane per hour to 2,000 vehicles per lane per hour. As a result of altering the capacity values for the freeway system without similar adjustments to the arterial system, or without revalidating the model, the forecasts produced by the model heavily favored the freeways. The overall traffic forecast in the Highway 101 corridor in 2015 did not increase significantly with this change to the capacity values on the freeways. Rather, the volumes on the freeway increased and the volume on adjacent parallel facilities decreased (in some cases to less than existing counts).

To refine the forecasts generated by the model, and distribute traffic more evenly across roadway facilities, a “screenline adjustment” method was applied. The method as outlined in the National Cooperative Highway Research Program (NCHRP) Report 255, adjusts volumes on individual roadway facilities based on the difference between the base year model and actual base year traffic count data across screenlines. Screenlines are imaginary lines cutting across parallel facilities which comprise a travel corridor.

Refinements were made to all of the 2015 forecasts (No-Build, Build, Enhanced Bus, Enhanced Rail, Pricing/Enhanced TDM). The first step in the process was to define a series of screenlines along Highway 101. Four screenlines were defined:

- South of Casitas Pass Road
- South of South Padaro Lane
- South of San Ysidro Road
- South of Salinas Street

For the parallel roadway segments cutting across each of these screenlines, existing traffic volume ground counts were obtained from Caltrans, the County of Santa Barbara and the Cities of Santa Barbara and Carpinteria. Base year (1990) and future traffic volume forecasts were obtained from the SBCAG model traffic assignment plots.

For each future forecast, the procedure used to refine the traffic volumes along individual roadways for each screenline is as follows:

- The total forecast 1990 traffic volume on each of the links which comprise the screenline were compared to the actual 1990 traffic volume ground counts, and the difference represented in absolute terms and in relative terms (percent of difference).

- The volume for the links in each screenline in the year 2015 forecast was adjusted first based on the absolute difference between the base and the modeled base, and then by the relative difference. The results were averaged to achieve a refined volume for each link on a screenline.

For the Build scenarios a different approach was required. This is because under the Build scenario, additional freeway capacity is available, thereby correctly making the freeway more attractive to traffic. The refinement was to correct for the overstatement of freeway attractiveness with the new freeway capacity (2,000 vehicles per lane per hour), compared to a Build assignment with the old capacity assumption (1,600 vplph). In this case, the existing ground counts compared to the 1990 forecasts were used to identify the absolute margin of error of the model and adjust the 2015 forecasts assuming 2,000 vplph. Then the adjusted year 2015 volumes assuming 2,000 vplph on Highway 101 were distributed to the various roadway facilities included in each screenline in the same proportion as in the 2015 forecast with 1,600 vplph. In this way, the order of magnitude increase in freeway volume which would occur with the addition of one lane in each direction of Highway 101 is correctly represented, while at the same time more realistically representing the traffic carrying relationship of the various roadways along the screenline (i.e. it is unlikely that, even with the addition of one lane in each direction on Highway 101, that traffic volumes on the adjacent arterials would drop below year 1990 levels).

The resulting <u>refined</u> forecast link volumes for each of the screenlines were incorporated in the analysis of each of the alternative packages and in the comparison of the alternatives to the Build and No-Build conditions.